



## NASA SBIR Select 2012 Phase I Solicitation

### E1.01 High Power Electric Propulsion Systems

Lead Center: GRC

Participating Center(s): JPL, MSFC

The goal of this subtopic is to develop innovative technologies for high-power (15 kW -class) electric propulsion systems. High-power (high-thrust) electric propulsion may enable dramatic mass and cost savings for lunar and Mars cargo missions, including Earth escape and near-Earth space maneuvers. At very high power levels, electric propulsion may enable piloted exploration missions as well. Improved performance of propulsion systems that are integrated with associated power and thermal management systems and that exhibit minimal adverse spacecraft-thruster interaction effects are of interest. Innovations are sought that increase system efficiency, increase system and/or component life, increase system and/or component durability, reduce system and/or component mass, reduce system complexity, reduce development issues, or provide other definable benefits. Desired specific impulses range from a value of 2000 s - 3000 s for Earth-orbit transfers to and for planetary flagship missions. System efficiencies in excess of 50% and system lifetimes of at least 5 years (total impulse > 1 x 10<sup>7</sup> N-sec) are desired. Specific technologies of interest in addressing these challenges include:

- Cathodes that address one or more of the following:
  - Long-life, high-current (100,000 hours).
  - Fast start.
  - Propellantless.
  - Operation on alternate propellants.
- Innovated designs for improved thruster performance and life.
- Electric propulsion systems and components for alternate fuels.
- Electrode thermal management technologies.
- Innovative plasma neutralization concepts.
- High-efficiency, lightweight power converters for high power (>10kW) DC discharge.
- Lightweight, low-cost, high-efficiency power processing units (PPUs) that accept variable input voltages of greater than 200V, including high temperature power electronics.
- Direct drive power processing units.
- Low-voltage, high-temperature wire for electromagnets.
- High-temperature permanent magnets and/or electromagnets.
- Advanced materials for electrodes and wiring.
- Highly accurate or fast acting propellant control devices and miniature flow meters.
- Superconducting magnets.

Note to Proposer: Subtopic S3.03 under the Science Mission Directorate also addresses in-space propulsion. Proposals more aligned with science mission requirements should be proposed in S3.03. For all above technologies, research should be conducted to demonstrate technical feasibility during Phase I and show a path toward Phase II demonstration, and delivering a demonstration package for NASA testing at the completion of the Phase II contract. *Phase I Deliverables* - Identify and evaluate candidate technology applications to demonstrate

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their technical feasibility and show a path towards demonstration via bench or lab-level demonstrations. The technology concept at the end of Phase I should be at a TRL range of 3-4. *Phase II Deliverables* - Emphasis should be placed on developing and demonstrating the technology under simulated mission conditions. The proposal shall outline a path showing how the technology could be developed into mission-worthy systems. The contract should deliver a demonstration unit for functional and environmental testing at the completion of the Phase II contract. The technology concept at the end of Phase II should be at a TRL range of 5-6.